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Bee Products as Functional Food

Banu Yucel, Erkan Topal and Mustafa Kosoglu

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Abstract

The studies that reveal the impact of the bee products on overall health are accompanied by new researches every year, and the importance of these researches are gradually on the rise. Bee products that are used as food and food supplements and drug concentrations in the historic process are drawing the attention with their marvellous characteristic features. The search for nourishment of the body on behalf of healthy living is currently being searched by many people. Therefore, the consumption of products that protect the health appears as the primary preference of people. In the light of this recent tendency, food sector is now offering well-supported products that are suitable for this preference. At this point, bee products such as honey, pollen, bee bread, royal jelly and propolis gain importance as functional food with their nutritious features that help in protecting the health. In this article, within the consideration of the researches that evaluate bee products as functional food, we aim to introduce the prominence of bee products in our nourishment and overall health.

Keywords: Bee products, functional food, health, prebiotic, probiotic

1. Introduction

At the present time, alterations in food production and consumption occur constantly. Standardized food production gradually gives its place to mass tailor-made production. Throughout this process, consumer needs also change and progress. In every aspect of life, the search for comfort increases its importance. Functional foods come to the light as a result of the search for comfort to fulfil certain needs. Functional food products become prominent within the several product groups particularly due to their direct effect on human health [1].

Functional foods are a highly important sector of the food market that grow rapidly. Within this concept, the interest towards the pro- and prebiotic foods increases by degrees. Foods that

beyond their basic nutritional features make positive contribution to our health are named as 'functional foods'. The term functional food underlines the positive relation of nutrition with health [2–5]. The International Food Information Council (IFIC) defines functional foods as 'foods and food components that may provide benefits beyond basic nutrition'. According to the International Life Science Institute (ILSI), the concept of functional foods refers to the 'biologically active components in foods that have the potential to optimize physical and mental well being' [6–13].

The most important target groups of the functional foods are women and elders. The new conception assimilates Hippocrates, the founder of the medicine, nearly 2500 years old philosophy 'Let food be thy medicine and medicine be thy food', and therefore pays more attention to the healthy nutrition. Nowadays, due to reasons such as the increase in the treatment expenses, labour loss, length of life and the portion of the old people inside the population and people's desire of living a quality life, people start to expect more from the food items [14].

According to the data of the research that is made to reveal the consumers' awareness, acceptance and approach towards the functional foods, mineral water, whole-grain diet biscuits and whole-grain breakfast cereals are the most frequently consumed functional foods in the order. The functional food increases the level of the beneficial bacteria in the gut, helps lose weight and supports child development. These three features of the functional food are emphasized by customers as 'the top 3 factors that convince them to consume functional foods' in the research [15].

Education level has advanced hand in hand with the economic development; therefore, people's demand to healthy foods has increased alongside with these progressions. The concept of functional food occurred for the first time in Japan in the 1980s. Functional foods are put on display for customers as an active food trend at the beginning of the 1990s in America and in the middle of 1990s in the countries of Europe.

According to the Foods for Specified Health (FOSHU) affirmed in Japan in 1991, it is stipulated that in order for a product to get functional food licence it is required to meet with certain criteria. Some of these criteria are stated in relation to bee products. Functional foods should help the improvement of the quality of nourishment, and protection and preservation of health, the compound of the product should not differ from the similar type of foods' nutritional substance components within normal conditions, the product should be a well-used food in daily diets, as all bee products have [16–19].

2. Bee products as functional food

Bee products are accepted as 'functional food' by adding them in other food products to increase their nutritional value or used alone with its natural and rich nutritional content and high bioactive components. Honey, pollen, bee bread, royal jelly and propolis have high nutritional value and beneficial effects that affect the human health in a positive manner. Bee

products are rich in proteins, simple sugars, essential amino acids and monounsaturated fatty acids. These features strengthen the immunity, help the body fight actively with bacteria and stimulate the quality tissue regeneration, and consequently protect overall body health and treat it [20] (see **Figure 1**).



Figure 1. Honey bee on combs and bee products on sale (photographed by M. Kosoglu and E. Topal).

Phenolic compounds	Honey ($\mu\text{g}/100\text{ g}$)	Pollen ($\mu\text{g}/100\text{ g}$)	Bee bread ($\mu\text{g}/100\text{ g}$)
Gallic acid	3.05	3.68	6.17
Protocatechuic acid	7.08	N.D.	91.25
Chlorogenic acid	N.D.	N.D.	N.D.
p-OH benzoic acid	8.98	N.D.	N.D.
Caffeic acid	79.90	N.D.	N.D.
Syringic acid	38.17	4.80	N.D.
Catechin	N.D.	N.D.	N.D.
Vanillic acid	41.40	5.30	N.D.
Epicatechin	N.D.	N.D.	N.D.
Ferulic acid	N.D.	6.62	28.38
Ellagic acid	N.D.	N.D.	N.D.
Rutin	56.66	50.80	217.20
P-coumaric acid	N.D.	N.D.	N.D.
O-coumaric acid	N.D.	3.25	N.D.
Quercetin	247.40	N.D.	N.D.
T-cinnamic acid	22.26	27.08	586.40
Apigenin	N.D.	N.D.	N.D.
Kaempferol	67.10	179.53	623.50

Table 1. Phenolic compounds of some bee products.

Bee products include many biochemical components that can be found on almost all functional foods. Proteins, saccharides, fatty acids, prebiotics, probiotics, fibre, phytochemicals, bioactive peptides, mineral matters, vitamins and organic acids can be shown as examples to these components. Additionally, phenolic acids, flavonoids and carotenoids that are found in the structure of bee products affect diseases such as cancer, arteriosclerosis, cardiovascular diseases, weakening of the immune system, Parkinson’s disease, Alzheimer, arthritis and photoageing dramatically as preventive and curative matters [21]. Especially flavonoids inhibit the efficacy of the enzyme systems that include lipid peroxidation, platelet aggregation, capillary permeability and lipoxygenase [22].

Bee products’ functional food features do not remain limited with these contents. Phenolic components in its structure make positive impact on body’s immune system in a crucial level [23]. Even in bee products which are procured by monofloral production, it is seen in **Table 1** that the phenolic component amount shows an alteration [22, 24] (**Table 1**).

The functional food feature and biological effect of bee products are fairly high [25, 26] (**Table 2**).

Product	Biological effect	Functional effects
Honey, pollen, bee bread, royal jelly, propolis	Antibacterial, fungicide, antiviral, antioxidative, immunomodulating and immunoactivating, anti-inflammatory, analgesic	Growth inhibition of pathogen bacteria, fungi, and viruses, anticancer, stimulate immune difference against inflammation
Pollen, royal jelly, propolis	Radioprotective, anti-arteriosclerotic, enhances Ca absorption	Protect against radiation, artherosclerosis and osteoporosis
Honey	Prebiotic (oligosaccharides), probiotic (contains probiotic bacteria)	Stimulates healthy digestion by promoting the growth of good intestine bacteria (<i>Bifidus</i> , etc.)
Royal jelly	Antihypertensive, vasodilative, increases reproduction and oxygen uptake of cells and has an effect on central and peripheral nervous system	Cardioprotective, stimulating and energizing against stress and fatigue, protection of the central nerve system

Table 2. Biological and functional effects of bee products [25, 26].

2.1. Honey

Honey is a bee prodomponents in its structure. Honey mainly consists of water and sugar that is formed from fructose and glucose. It includes ascorbic acid, pantothenic acid, niacin vitamins and additionally mineral substances such as manganese, phosphor, potassium and zinc [27] (see **Figure 2**).

Honey is a functional food that contains inulin and fructo-oligosaccharide (FOS) and it has prebiotic features that have beneficial effects to our gastrointestinal system. As widely known, prebiotics are undigested carbohydrates which increase the activity and number of both

column bacteria and probiotics (living organisms that regulate the intestinal microbial balance). According to the identified data, prebiotics stimulate the immune system and help the inhibition of carcinogenesis inside the column [28, 29]. As a result of prebiotics' fermentation in large intestine, substances such as lactate, short-chain fatty acids (acetic, butyric and propionic acids), hydrogen gas, carbon dioxide and methane are produced. The intestine's pH drops significantly. The drop in the intestinal has many benefits such as inhibition of microorganisms that can potentially have detrimental effects, degradation of secondary bile acids, increment of the solubility and absorption of minerals such as Ca, Mg, Fe and Zn [30]. Undigested carbohydrates that are known as prebiotics include lactulose, lactitol, oligosaccharides and inulin. Undigested oligosaccharides are found naturally in fruits, vegetables, milk and honey [31].



Figure 2. Honey (photographed by E. Topal).

Inulin is a term that is used for heterogeneous mixture of fructose polymers that are found commonly in the form of stored carbohydrates in nature and has a polymerization degree that alters between 2 and 60°. The units that have lower polymerization degree (2–20) are called fructo-oligosaccharide or oligofructose [32]. The consumption of 4–10 g of fructo-oligosaccharides in daily basis creates bifidogenic effect, thus increasing the number of beneficial bacteria [33].

Honey is not only a functional food but also has many positive impacts on human health. Due to these impacts, it is used countless times in folkloric medicine and its usage as a drug put on the records centuries ago for us to read the crucial role of the honey in our life [34]. In addition to that, honey comes forward as an important antioxidant source due to its vitamin C, flavonoids and phenolic content [35, 36]. Honey's strong biological activity originates from its rich phenolic content. Flavonoids stimulate antibacterial, antiviral, anti-inflammatory and

vasodilator effect [21, 22]. Flavonoids and phenolic acids form the most common group of plant phenolics [37]. Phenolic acids and flavonoids act as free radical scavengers due to their reducing agents besides their antioxidant and anticarcinogenic effects [38–40]. Flavonoids increase the mucosal content of prostaglandins and have an important inhibitory effect on the gastric mucosa, thus preventing ulceration. Mucosal content of prostaglandins has an important inhibitory effect on acid secretions, preventing the formation of peptic ulcers [22].

Antibacterial feature of honey that comes from its osmotic effect is an outcome of the sugar molecules in the setting which drain the water around and leave so little to the microorganisms that cause the bacteria in the honey to die from dehydration. Alongside with this osmotic effect, hydrogen peroxide that is constituted from glucose oxidase in honey creates the same level of antibacterial activity. By the time that hydrogen peroxide decomposes, it produces highly effective free radicals and consequently these situation cause bacteria to die. Due to this feature, it can be understood that honey defends the body successfully against the destructive effect caused by oxidative stress [34, 41].

In a research aimed at studying the long-time storage of the honey as a functional food, honey and pollen are fermented by probiotic lactobacillus and conserved at 40°C for 7 days to examine the prebiotic cells' liveliness. In consequence of the examination, it is found out that prebiotic stains preserve their liveliness at a significant level [42].

Honey's role as a protector of the overall health and creator of an antioxidant effect makes it useful in the food sector for long ages. The sugar known as 'Maillard Reaction' forms a composition of aldehyde-ketone and amine interaction that has an antioxidant feature. In other words, honey diminishes the microbial activity that starts after cutting the meat which gets harmful for the health [43]. Furthermore, the usage of the honey in chicken meat makes its water-holding capacity to increase, prevents boiling of loss, balances pH, gives a light colour to the meat by Maillard reaction and provides richness in flavour [44–46]. Correlative to its fructose content, honey enhances the flavour of the meat and increases its nutritional value due to its 'functional food' feature [47].

The antioxidant effect of honey can be evaluated with the lipid peroxidation system. Honey stops the bacterial growth in dry-aged and wet-aged meats and even acts like a bactericide when it gets together with propolis. The strong antioxidative and antibacterial activities of honey clean the active oxygen that cause meat to go bad [48]. Additionally, it is found out that in chicken meats that have been marinated with honey, the formation of heterocyclic amine that occurs as a result of Maillard reaction after cooking drops at a rate of 92–99%. As a reason behind this drop, it is submitted with the acidic structure of honey that prevents the occurrence of amine [49]. Phenolic and flavonoid compounds inside the honey's composition increase the capacity of the antioxidants and prevent the activation of hydrogen peroxide [48]. According to a conducted research, chicken meats that have been marinated with different portions of honey significantly prevent bacteria growth by comparison with the group that has not been treated with the honey whatsoever [46].

2.2. Pollen

Pollen is a bee product, which serves as an important food supplement thanks to its content that not only includes rich food substances as a male reproductive unit of the flower but also consists of salivary juices of honeybee. It is accepted as a 'natural drug concentration' due to its content that consists of enzymes, coenzymes, steroids, vitamins, antibiotics, microelements, carotenoids and flavonoids. Pollen's strong antioxidant feature originates from high level of polyphenols in its content. Due to this feature, it is considered as a functional food/food supplement [50]. Generally obtained from bees from various plants, pollen is accepted as 'the most distinguished food in the World' [51]. The composition and chemistry of pollen is not standardized. The type and characteristic of pollen alters in accordance with the kind of the plant that it is obtained from, the season, climate, environmental aspects and the age of the plant. The alterations, which depend on the structure of the plant that the pollen is acquired from, change the compounds of pollen and the level of impact that it has on health. For instance, meanwhile a willow's pollen is rich in vitamin C, a clover's and willow's pollens are rich in flavone matter. This content protects the body from sclerosis, spasmodic and radioactive effect. Due to willow's and cherry's pollens' chlorogenic acid content, they protect vascular health, act as an anti-inflammatory and regulate thyroid and pituitary glands' secreted hormones. In addition to the effects of the pollens acquired from one plant type only, pollens collected from thousands of various types of flowers in the nature have exceptionally beneficial effects. For that reason, it is stated that the consumption of mixed pollens has positive impact on health [41] (see **Figure 3**).

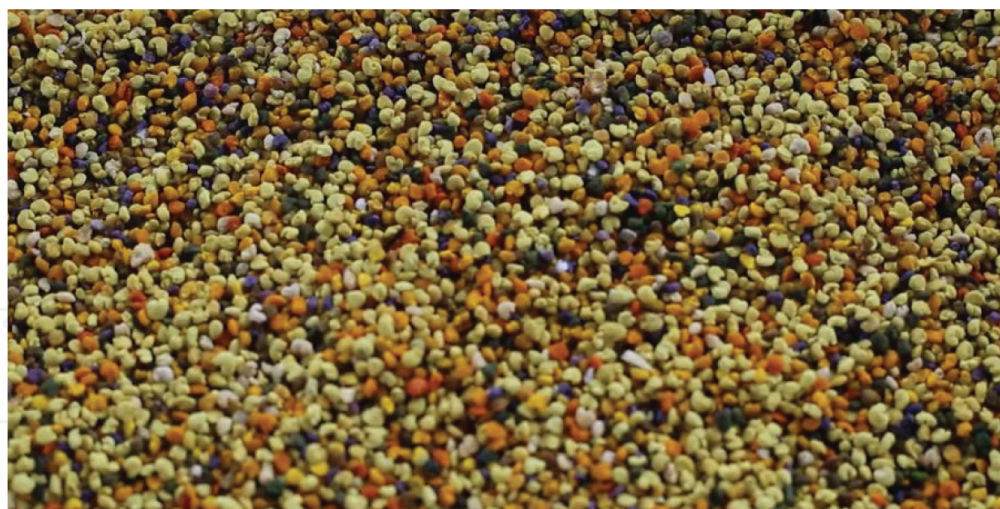


Figure 3. Pollen (photographed by M. Kosoglu).

Pollen's important antioxidant level is mostly connected with the phenol compounds [52]. In the conducted research made in Brazil, in 25 examples which are collected on certain days for 9 months, isoquercetin, myricetin, quercetin, luteolin, selagin, kaempferol and isorhamnetin substances are identified. Even though the flora that the bee worked on has changed, it is noted that there were not excessive differences in phenolic composition level [53].

Pollen is accepted as a dense nutraceutical substance based on its phenolic compounds and high antioxidant activity. It regulates the blood flow in lecithin vessel. Pollens stimulate the production of polyphenols and biocides in liver and clean the liver by decreasing the oil level. At the same time, pollen is a food supplement that is extremely rich in selenium which plays a crucial role in protecting the cardiovascular health. The consumption of the pollen, which is considered as both 'functional and super food', is recommended for 15–20 g a day, two times a year in weekly cures for 3 weeks [54].

According to the results of the research made to examine the effects of physico-chemical and microbiological features of yogurts produced by honey, pollen and probiotic yeast, it is identified that there are significant increases in the amounts of oil and protein in yogurt due to the pollen addition [5]. Another study revealed that the probiotic yogurt produced by adding pollen has a positive impact on both physico-chemical and sensorial features [55]. Unfortunately, the positive impact of the addition of pollen in the yogurt on senses of taste and smell is revealed to be not the same in the case of adding the pollen in milk. It is reported that even though the addition of pollen in milk does increase the probiotic feature, sensorial features are effected negatively [56].

A conducted research presented that in order to extend the shelf life of meats, pollen can be added to the mincemeat as an antioxidant and antimicrobial agent. It is revealed that the lipid oxidation and microbial growth are prevented by pollen supplementation [57].

Adding pollens inside the whole-grain biscuits is a common way of consuming pollens. It is stated that adding an amount of 5% of pollen as a food supplement inside the biscuits does not affect the oil amount but does affect the amounts of sugar and protein at a significant level [58].

2.3. Bee bread

Bees mix pollen with honey and their digestive enzymes and then the whole composition will be fermented by the lactic acid. The final state of this mixture is called 'bee bread' which is an extremely valuable product. In apiculture, this valuable product can be put onto the market as a nutraceutical human food/food supplement. Bee bread includes a significant amount of proteins, vitamins and one of the natural antioxidants, the phenolic compounds. The flora that is found at the region where colonies are present has a significant impact on the compounds of the bee bread. Honey bees ferment hidden pollens inside the comb with various enzymes and the addition of honey then stores it as bee bread. This implementation provides a more advantageous storage against the risk of nutrition loss of the dried and frozen pollen [20] (see **Figure 4**).

The positive effect it has on health and its content that is full of rich polyphenols make bee bread medically the focus of interest [59]. In a research, which has examined the bioactive features of cherry pollens and bee bread, it is found out that these bee products have high antioxidant and anti-inflammatory capacities with their content, including 1371 mg/100 and 1428 mg/100 g high phenolic compounds [24]. A converted research made in Colombia to analyse the bee bread, flavonoid and phenolic matters' content are found 3.2 ± 1.0 mg

(quercetin/g) and 8.9 ± 3.1 mg (galia acid/g.), respectively. Additionally, ferric-reducing antioxidant power (FRAP) and 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid) (ABTS) antioxidant activities are reported at a level of 46.1 ± 13.0 versus 61.5 ± 10.2 mmol (trolox/g), respectively, and according to the data bee bread can be digested with more ease and biologically used at a higher level than pollen. This case shows the fact that bee bread has a higher nutritional level and more amount of usable bioactive compounds than pollen. According to the obtained results, as a functional food supplement bee bread is a product that has a high level of utilization potential [60].



Figure 4. Bee bread (photographed by M. Kosoglu).

2.4. Royal jelly

It has different colours changing from cream to dark yellow, an acidic structure and an astringent taste. Royal jelly includes all the food substances necessary for the larva's growth. It is quite rich in proteins, oils, sugars, hormones, vitamins and mineral matters. Chemically, royal jelly comprises water (50–60%), proteins (18%), carbohydrates (15%), lipids (3–6%), mineral salts (1.5%) and vitamins together with a large number of bioactive substances such as 10-hydroxy-2-decenoic acid with immunomodulating properties, antibacterial protein, fatty acids and peptides. The royal jelly also demonstrated significantly improved recovery from 5-fluorouracil-induced damage [61, 22]. The quality of the royal jelly is evaluated by 10-hydroxy-2-decenoic acid (10-HDA) level in its content and the level of the matter is expected to be found among 1.4 and 1.8% levels. This value can differ due to the vegetation of the region where royal jelly is obtained from and the implementation techniques in harvesting royal jelly. Unlike honey, the mineral matter composition in royal jelly is not affected by the topography nor the flora [62] (see **Figure 5**).



Figure 5. Royal jelly in cells and harvesting royal jelly (photographed by M. Kosoglu).

Royal jelly is a very complex bee product in terms of the content of compounds. Components in its compound target various biological functions both known and unknown, and therefore they play a crucial role on the biomedical effect of the royal jelly [63].

Royal jelly stimulates cell renewal, production and metabolism and due to these effects it creates liveliness, health, energy and high immunity and vigour in all the tissues of the organism. Its content is rich in natural hormones, vitamins, essential fatty acids, amino acids, sterols, phosphor compounds and acetylcholines. Acetylcholine is effected in the transmission of the neurons' messages and regulation of the work of endocrine glands. Being rich in building blocks of life, royal jelly's rich content of the gelatinous amino acid, which is the fundamental component of collagen and therefore the royal jelly, has an anti-ageing effect. The gammaglobulin in the content of the royal jelly effects the body's capacity to fight with the infections and acts as a strengthening factor to the immune system. With its decanoic acid content, royal jelly has a strong antibiotic effect to many bacteria and fungus. Due to its fight with tumours and metastasis, it is reported that royal jelly is used in oncology, psychiatry and neurology, geriatrics, bone and cartilage tissue regeneration, vessel stiffness, growth and development. It is actively used to stop physical exhaustion. Royal jelly not only lowers the cholesterol, total lipid, phospholipid, triglyceride and b-lipoprotein levels in blood but also lowers the overall cholesterol and acts as a vasodilator. Because of the fact that it consists of inulin-like peptides, royal jelly shows hypoglycaemic and immunological effects. In the case of feeding premature and undernourished babies with 8–100-mg royal jelly, it is reported that there were significant improvement on their overall health condition, weight gain, increase on the levels of red blood cells and haemoglobin [41–65]. In addition to all these features, the significant impact of the consumption of royal jelly has on sperms and its mobility and the positive results obtained from the infertility treatment when consumed regularly are reported [66].

2.5. Propolis

Propolis is a resinous substance that bees collect from the exudates of plants and which they use to seal holes in the bee hive [67]. Propolis, too, forms part of traditional medicine, and chemical analysis has pointed to the presence of at least 300 compounds in its composition. It

is mainly composed of resin (50%), wax (30%), essential oils (10%), pollen (5%) and other organic compounds (5%). Among these organic compounds, we may find phenolic compounds and esters, flavonoids in all their forms (flavonoles, flavones, flavonones, dihydroflavonoles and chalcones), terpenes, beta-steroids, aromatic aldehydes and alcohols, sesquiterpenes and stilbene terpenes. Caffeic acid phenethyl ester (CAPE) is a biologically active ingredient of propolis with several interesting biological properties, including apoptosis, metastasis and radiation sensitivity of cancer cells [68–71] (see **Figure 6**).



Figure 6. Raw propolis and honey bee (photographed by M. Kosoglu).

The impact that propolis has on cancer bases on especially its regulative and strengthening role on the immune system. Based on this strong effect of propolis, whether propolis shows cytotoxic and apoptotic features in acute lymphoblastic leukaemia cell lines or not is searched, and found out that due to its caffeic acid and phenethyl ester content, propolis shows a significant level of cytotoxic effect and stops tumour growth [72]. According to the results of the research which searches especially for the inhibitory effects of propolis on osteogenic sarcoma cell growth, due to the anticarcinogenic effect of the apoptosis mechanism induced with the propolis extract, it is reported that propolis can be beneficial in cancer treatment [73]. Along with many polyphenols and antimetastatic effects propolis has, it is been observed that the compounds CAPE obtained from *populus*' propolis and Artepillin C obtained from *Baccharis propolis* show antitumoural effects [74].

The usage of propolis is recommended by patients who take radiotherapy during their cancer treatment. Propolis acts almost like a protective barrier and prevents the radioactive ray from affecting the healthy cells and makes it effective only to the distorted tissues. By this way, the level of radiation entering inside the patient's body decreases. Additionally, due to the

strengthening feature of propolis on the body's immune system, it supports patient's body functions and therefore increases body's resistance. Propolis should be implemented as a complementary supportive care that is accompanied by conventional surgery, chemotherapy and radiotherapy. It is crucial to use it with an ethical and responsible approach and in right doses and for enough time [75].

Propolis and its derivatives have the capacity to inhibit virus propagation. Several *in vitro* studies have shown the effect of propolis on the DNA and RNA of different viruses, among them Herpes simplex type 1, Herpes simplex type 2, adenovirus type 2, vesicular stomatitis virus and poliovirus type 2. The effects observed involve a reduction in viral multiplication and even a virucidal action [22].

The antiseptic, antibiotic, antibacterial, antifungal and antiviral features of propolis come from its galangin, caffeic and ferulic acid content. In converted researches, propolis is used in branches and diseases such as dentistry, oto-rhinolaryngology, ophthalmology, gynaecology, dermatology, digestive system diseases and pulmonary diseases besides its cancer and radiation treatment [76].

The antioxidant, antimicrobial and antifungus effects of propolis are benefited by food technology. In a converted study, 0.02 and 0.4% of ethanolic propolis extract (EEP) and 0.28% of potassium sorbate are added in meat products that are mixed with stored fats and it is stated that meat products treated with propolis have a longer shelf life than the ones mixed with potassium sorbate [77]. Similar studies determine the fact that propolis has a significant level of antibacterial effect and propolis extracted in 0.3% ethyl alcohol extract and in water can be used successfully in meat products as a natural coating compound [78, 79]. In these studies, propolis forms a surface such as a film badge during the marination and its prevention of the microbial activity is remarked. Additionally, the utilization of propolis decreases the level of the total volatile nitrogen content (TVB-N) and thiobarbituric acid (TBA) that affects the processed meats badly. Due to these features of propolis, it is recommended for use as a decent preservative in processed and unprocessed meats [77].

In a research that has specified the physico-chemical and microbiologic alterations in meat's structure, as a result of treating the beef hamburger meats with propolis ethanol extract (PEE) and freezing them for 8 months at -18°C , it is observed that propolis extends the shelf life without affecting the quality of meat negatively [80].

The impact of different propolis concentrations (250, 500 and 1000 ppm, respectively) on the microbial load on the surface of the Roumy cheese is searched and it is found that propolis inside the 1000 pm concentration completely prevents the production of mould and stigmatosis in the cheese; therefore, the utility of propolis in foods as an economic and natural preservative is indicated as a result of the research [81].

In a research examining the bactericidal and bacteriostatic activity against the *Escherichia coli* bacteria *in vitro*, 20% EEP is recommended to be evaluated as a natural food preservative due to its neutralization of *E. coli* bacteria [82]. In a similar way, the antibacterial effect of the propolis on some of the fermentative bacteria in yogurt is examined and the inhibitory impact of the propolis even at low concentration on the normal bacteria growth is stated [83].

In a research that has identified the antifungal effect of the propolis extract on the six types of yeasts which cause unpasteurized fruit juices to go bad, it is revealed that propolis can be used as an alternative to the chemical preservatives in fruit juices due to its antibacterial effect [84].

3. Conclusion

The improving technology and changing living conditions alter human life and nutritional habits, and as a conclusion the thought of preventing diseases by being nourished with functional and super foods enriched with natural preservatives and substances that protect the health become extremely popular. More studies are needed on the contribution of the magnificent bee products have on our health and nourishment in order to create more awareness and influence the production of qualified bee products and increase the conscious selection and consumption of the bee products made by consumers. Making multidisciplinary scientific researches about the protective effects of the bee products as functional foods that meet with the common trend of 'not getting sick' will significantly contribute to spreading the results of the researches all around the world and improving the sector.

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Author details

Banu Yucel^{1*}, Erkan Topal² and Mustafa Kosoglu²

*Address all correspondence to: banu.yucel@ege.edu.tr

1 Ege University, Faculty of Agriculture, Department of Animal Science, Bornova, Izmir, Turkey

2 Aegean Agricultural Research Institute, Beekeeping Unit, Menemen, Izmir, Turkey

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